# PACKAGING MACHINE COMPRISING SEVERAL LIFTING DEVICES PER WORKING STATION

The present invention relates to a packing machine with at least one working station, which exhibits at least one upper tool and a vertically displaceable lower tool, whereby the lower tool comprises several lifting devices arranged parallel to one another.

Nowadays, foodstuffs are often packed in plastic packaging in order to preserve them. The manufacture and filling of the packaging units takes place as a rule in a semi-continuous packaging machine, operating cyclically, in which the packaging troughs are first thermoformed from a film, then filled with the goods which are to be packed, and then sealed with a cover film. The packaging units manufactured in this way are cut apart from one another in the final step. The film is moved further onwards by a certain length per cycle. As a rule, several packaging troughs are simultaneously moulded, filled, sealed, and cut. During the manufacture of the packaging, tools, such as the thermoforming tool, the sealing tool, or the cutting tool are moved vertically. The packaging machines according to the prior art currently have the disadvantage that not enough packaging units can be manufactured per time unit.

The object of the present invention is therefore to provide a packaging machine with which the disadvantages of the prior art are overcome.

This object is resolved according to the invention by a packaging machine with a working station which exhibits an upper tool and a vertically displaceable lower tool, whereby the lower tool comprises several lifting devices, for preference arranged parallel to one another and/or a lifting device exhibits at least three lifting shafts.

It was entirely surprising for the person skilled in the art and not to be expected that, with the packaging machine according to the invention substantially more packaging units can be manufactured per time unit. The packaging unit according to the invention allows for film feed of any desired length per cycle, and therefore the simultaneous manufacture of a plurality of filled packaging units. The packaging machine according to the invention is simple and economical to manufacture and operate.

According to the invention, the lower tool exhibits several lifting devices arranged parallel to one another, so that the lower tool can be moved up and down by several lifting devices. A lifting device in the meaning of the invention exhibits at least one drive unit, such as a motor and/or a cylinder. For preference, the drive is connected to a means, a transmission system, which converts a rotational and/or linear movement into an upwards and downwards movement and/or supports the individual movement. Such means are, for example, a toggle drive, a plate cam, a cam, and/or a nut/spindle combination. In relation to the direction of run of the film web these lifting devices can be arranged next to one another as well as behind one another, whereby an arrangement behind one another in relation to the movement of the film is preferred.

For preference, the lifting devices are of identical design.

For further preference, the lifting devices can be operated independently of one another. This embodiment of the present invention that the user does not have to operate all the devices at the same time, so that, depending on the length of the film feed, he can select the number of the lifting devices used. In this case it is of advantage if the lower tool of the individual working station is designed in several parts, according to the number of the

lifting devices. In this case, in each case a part of the lower tool is allocated to a lifting device. In the event of not all the lifting devices being used, one or more of the lifting devices can serve as redundancy.

In a further preferred embodiment of the present invention, the lifting devices are controlled by a central control unit. This embodiment of the present invention is particularly advantageous if the lifting devices must be operated in synchrony.

For preference a lifting device exhibits two drive means.

For further preference, each drive means interacts with at least two lifting shafts in each case.

For very specific preference the drive means operate in counter direction.

The invention is described hereinafter on the basis of Figures 1 - 4.

Figure 1 shows the structure in principle of a thermoforming packaging machine.

Figure 2 shows a perspective representation of a toggle drive system in the raised position.

Figure 3 shows a toggle drive system with three lifting shafts.

Figure 4 shows two lifting stations for a working station arranged in series.

Figure 1 shows the packaging machine according to the invention in a diagrammatic representation. A film 1 is unrolled from a roll in a cyclic manner, and first runs

through a thermoforming station 2, which consists of an upper tool 3 and a lower tool 4. The lower tool is mounted on a plate 5, which, as indicated by the arrow, can be raised and lowered. In the thermoforming station 2, at least one but in most cases several packaging troughs 6 are formed in the film 1. The number and arrangement of the packaging troughs which can be produced simultaneously in one cycle are conveyed further cycle by cycle, filled with the goods to be packaged, and in the sealing station 10 which follows the packaging troughs are sealed with a cover film. The length of the advance per cycle is based on the number of the packaging troughs which are manufactured simultaneously. Currently cycle lengths >= 1200 mm are being striven for. The sealing station 10 consists of an upper tool 12 and a lower tool 11, whereby at the sealing station also the lower tool 11 can be raised and lowered.

The packaging elements are then cut apart in the cutting station 7, which likewise consists of an upper tool 8 and a lower tool 9, whereby the lower tool 9 can be raised and lowered at the cutting station also.

The thermoforming station 2, the sealing station 10, and the cutting station 7 are also designated hereinafter as working stations 2 10, 7. The working stations each exhibit tools which, also designated heretofore as upper tools 3, 8, 12, are provided as stationary or capable of being lifted, and are designated hereinafter as stationary parts 3, 8, 12. The working stations 2, 10, 7 can in particular be secured to one or more rails, not shown, running essentially horizontally, by means of what are referred to as suspension points which are located at the working stations 2, 10, 7. The working stations can in particular be displaced horizontally on the rails. The working stations each exhibit tools which, also designated heretofore as lower tools 4, 9, 11, which can lifted or lowered, and are referred to hereinafter as lifting parts

4, 9, 11. It is indeed to the purpose, although not absolutely necessary according to the invention, that the lifting parts 4, 9, 11 be arranged beneath the stationary parts 3, 8, 12. It is likewise to the purpose, although not absolutely necessary according to the invention, that the stationary parts 3, 8, 12 be arranged at a working station above the lifting parts 4, 9, 11. The lifting parts are, according to the invention, to be raised or lowered in relation to the stationary parts by way of at least two means 50. The means 50 are also designated hereinafter as the lifting table.

According to the invention, at least one working station but for preference all of them exhibit at least two lifting tables, which for preference are arranged behind one another in relation to the direction of run of the film. The lower tools can be designed as multi-part, whereby in this case the number of parts corresponds to the number of lifting devices.

An example of a lifting table is represented in Figure 2. The lifting table 50 has a plate 5, on which the lifting parts 4, 9, 11 can be mounted. The plate 5 is provided with two guide bushing 61, which accommodate guide rods 51. Further carrier rods 52 carry a securing device 53 for the stationary parts 3, 8, 12, not represented in Figure 2. The lifting table 50 is designed according to the invention in such a way that it can be used so as to be displaced horizontally in the mounting rails 15, not shown in Figure 2, by means of several suspension points 54, such as four suspension points 54. The securing device 53 and therefore the stationary part 3, 8, 12 can, in a preferred embodiment of the lifting table 50, be provided so as to be displaced vertically in relation to the suspension points 54. Such a vertical displacement or movement of the stationary part 3, 8, 12 can be provided for, for example, by a lifting actuator 55, which is provided in particular in the form of

an electric motor, for example by means of a spindle drive or the like. The carrier rods 52, according to the invention, can likewise, in addition to their function as carrier rods 52, also exercise a function as guide rods for the plate 5 or the lifting part 4, 9, 11 respectively. In this case, provision can be made for additional guide rods 51 to be done without, and for the carrier rods 52, 51 to be used as guide rods. On their under side the plate 5 exhibits bearings 62, in which the upper ends 63a of rods 63 can be mounted so as to pivot about axes. The rods 63 are connected at their lower ends 63b in a rotatable manner by means of arms 64 to a first lifting shaft 65a and/or a second lifting shaft 65b respectively, whereby the lifting shaft in turn is rotatably mounted in yokes 66. The yokes 66 are securely connected to the carrier rods 52. The yokes 66 can, however, also be mounted so as to be axially displaceable and on a spring element, in order to compensate for fluctuations in film thickness and to avoid the packaging machine being damaged in the event of an excessive upwards lift. The spring force in this embodiment is somewhat greater than the desired sealing or cutting force. The arms 64 and the rods 63 form toggle lever systems, which convert a rotational movement of the lifting shafts 65a, 65b into a translational or linear movement of the plate 5 and therefore of the lifting parts 4, 9, 11 relative to the stationary part, not represented in Figures 2 to 4. In this situation, the first toggle lever system is located at the first lifting shaft 65a and the second toggle lever system at the second lifting shaft 65b. In this situation, the first toggle lever system may readily comprise a plurality of toggle levers, which are provided on the first lifting shaft 65a. Likewise, the second toggle lever system may comprise a plurality of toggle levers, which are provided on the second lifting shaft 65b. In the example in Figures 2 to 4, two toggle levers are provided in each case on both lifting shafts 65a, 65b. The first and second lifting shafts 65a, 65b are moved by means of an

electric cylinder 68 (Messrs. Parker Hannifin GmbH) exhibiting a first contact point and a second contact point. To do this, a first lever 67a is provided at the first lifting shaft 65a and a second lever 67b at the second lifting shaft 65b. The first contact point is provided at the end of the first lever 67a facing away from the lifting shaft 65a, and the second contact point is provided at the end of the second lever 67b facing away from the second lifting shaft 65b. In the extended state of the lifting device 50, represented in Figure 2, the lifting part 4, 9, 11 and the plate 5 are at their highest position, because the arms 64 and the carriers 63 are in each case arranged essentially linear behind one another. In this situation, in the embodiment represented, the electric cylinder 68 is completely retracted, i.e. the contact points exhibit the shortest distance interval between them. The plate 5 and therefore the lifting part 4, 9, 11 come to be lowered when, due to the extension of the electric cylinder 68, a rotation of the lifting shafts 65a, 65b is caused, with the toggle lever systems folding in as a result. This movement is indicated in Figure 2 by means of the arrows 69. According to the invention, this movement is carried out uniformly for both lifting shafts 67a, 67b for both toggle lever systems, so that the plate 5 does not tilt. To achieve this, compensation means are provided according to the invention at the lifting device 50. A first possibility for such compensation means is to provide guide bushings 61. The longer the guide bushings 61 are provided for, the better the guidance of the lifting part 4, 9, 11 in the guide rods 51, and therefore the better its securing against tilting. A further possibility for such compensation means is to ensure a synchronised and opposed movement of the lifting shafts 65a, 65b, in that a link chain, a toothed belt, a tooth arrangement, a drawing means, in particular a wire wound several times onto the lifting shafts 65a, 65b, is provided between the lifting shafts 65a, 65b. Compensation means which cause a

synchronised movement of the lifting shafts 65a, 65b, i.e. with the same effective arm lengths at both toggle lever systems, in particular a uniform and opposed movement, by means of toothed wheels, chains, or the like, are also designated hereinafter as direct compensation means. In the area of the yoke 66 between the lifting shafts 65a, 65b a wire (not shown) is connected to the lifting shafts 65a, 65b, crossed in such a way, in particular by means of one or several windings, that in the event of an opposed movement of the rotational movement of the lifting shafts 65a, 65b, i.e. with different direction of rotation, the wire will be unwound upwards from the one lifting shaft and simultaneously wound up downwards by the other lifting shaft, and vice-versa. This guarantees that the force effect of the electric cylinder 68 is transferred directly and uniformly onto both toggle lever systems. More substantial friction resistance of the one system are compensated, for example, by compensation means. This guarantees that the movement of the lifting device exhibits only one degree of freedom, and that the height of the plate 5 is determined in an unambiguous manner by the extension state or retraction state of the electric cylinder 68. Compensation means, which indirectly cause a synchronised movement of the lifting shafts, such as, for example, lengthened guide bushings 61, are also designated hereinafter as indirect compensation means. Provision is made according to the invention for direct and indirect compensation means to be used both cumulatively as well as alternatively. In this situation, care is to be taken to ensure that the compensation means exhibit as far as possible no slippage. This can be achieved, for example, by spring means being integrated in the compensation means. In a particularly advantageous embodiment, the wire 71 is provided with a tensioning means or a spring means 70, for example a helical spring capable of linear rotation along its axis, whereby the wire 71 is provided crossed between the lifting shafts 65a, 65b, and the spring means 70

tensions the wire 71. In the example shown in Figure 4, the spring means 70 are provided in such a way that any slippage which might occur of the compensation means provided as a wire 71 will be suppressed. In an alternative embodiment, not represented in Figure 4, the wire 71 is provided with a tensioning means or a spring means 70, which is provided at the wire 71 or at the lifting shafts 65a, 65b respectively in such a way that, when the plate 5 is lifted, there is a deflection of the spring means 70. In a further embodiment of the invention, not represented, provision is made for a chain or a toothed belt to be provided crossed between the lifting shafts 65a, 65b. In this case, it is possible with particularly simple means to cause an opposed direction of rotation of the lifting shafts 65a, 65b.

The person skilled in the art will recognise that the lifting table can also be operated with a pneumatic or hydraulic cylinder.

Figure 3 shows a lifting device with three lifting shafts 65a - c and two linear cylinders 68, whereby one linear cylinder drives the lifting shafts 65 b and c, and the other cylinder drives the lifting shafts 65 a and b. The person skilled in the art recognises that, if appropriate, even one cylinder 66 is sufficient to provide the drive. The linear cylinders are connected on the one hand to the yoke 66 and, on the other, to the levers 67 a and b, and 67 b and c respectively. The levers 67 a - c are in turn connected to the lifting shafts 65 a -c in a torsionally resistant manner. The person skilled in the art recognises that the electric cylinders work in opposed directions. In the upper position shown of the plate 5, at the rear electric cylinder the lifting rod is fully retracted, while at the front electric cylinder it is fully extended. In the lowered position of the plate 5, the circumstances are precisely reversed. The person skilled in the art

recognises that the cylinders 68 can in each case also be mounted on the shafts 65a and 65c respectively by bearings.

By way of supplement, reference is made to the embodiment in Figure 2.

Figure 4 shows two lifting stations 50 arranged in series, i.e. arranged one behind the other in the direction of run of the film. The width of the two lifting stations 50 in the direction of the run corresponds essentially to the feed length of the film during a cycle. Due to the connection behind one another of several lifting stations, it is possible for almost any feed lengths to be achieved during a cycle, without certain lower limits, for example at the pressing of the lower tool onto the upper tool, underpressure during thermoforming and/or the contact pressure during sealing being undercut. It can clearly be recognised that the two lifting stations are not of equal length. The person skilled in the art will recognise that this does not have to be the case, depending on the desired contact pressure of the lower tool onto the upper tool. In addition, the person skilled in the art will recognise that beams 90 on which the individual lower tool (not represented) lies are, by contrast with the prior art, arranged transverse to the direction of run, which is rendered simpler thanks to the modular design. The two lifting stations each have a drive, but are driven completely synchronously.

The lifting device can be designed in all embodiments which are shown in DE 103 51 567.4 also as in EP 0 569937.

Reference list

| | |
|---|---|
| 1 | Film |
| 2,7,10 | Working stations |
| 3,8,12 | Stationary part/upper tool |
| 4,9,11 | Lifting part/lower tool |
| 5 | Plate |
| 6 | Packaging trough |
| 15 | Mounting rails |
| 50 | Lifting device/lifting table |
| 51 | Guide rods |
| 52 | Carrier rods |
| 53 | Securing device |
| 54 | Suspension point |
| 55 | Lifting actuator |
| 61 | Guide bushings |
| 62 | Bearings |
| 63 | Rods |
| 63a/63b | Upper/lower ends of rods |
| 64 | Arms |
| 65a-c | First/second lifting shaft |
| 66 | Yoke |
| 67a-c | First/second lever |
| 68 | Electric cylinder |
| 69 | Arrow |
| 70 | Spring means |
| 71 | Drawing means, wire in particular |
| 80 | Direction of run of the film |
| 90 | Beams |